CHAPTER 4

SYSTEM RESERVOIRS

PURPOSE

The system reservoir holds enough fluid to keep the hydraulic system operating properly. It also replaces fluid lost through minor leakage or evaporation. Reservoirs--

- Provide space for fluid volume that increases over the initial amount; for example, an increase might occur through thermal expansion or foaming.
- Provide an escape for air trapped in the system.
- Help cool the system fluid.

TYPES

The two types of reservoirs used in aircraft hydraulic systems are the in-line type and the integral type. The in-line reservoir has its own housing, is complete within itself, and is connected with other components in the system by tubing or hose. The integral type consists of a space that is set aside within some major component to hold a supply of operational fluid; it has no housing of its own. The in-line reservoir is the type commonly used in Army aircraft.

A space is provided in the in-line reservoir above the normal fluid level for fluid expansion. This space also enables trapped air to escape. Reservoirs are never intentionally filled to the top with fluid. In fact, most reservoirs are designed so that they cannot be overfilled during servicing. This is done by locating the rim of the filler neck below the top of the reservoir. Most reservoirs have a dipstick or glass-sight gage that enables the fluid level to be easily and accurately checked. All reservoirs are either vented (open to the atmosphere) or pressurized (closed to the atmosphere).

Vented Reservoirs. In vented reservoirs, atmospheric pressure and gravity are the forces which cause fluid to flow out of the reservoir and into the pump. To supply a pump with fluid, a vented reservoir must be positioned at a higher location than the pump. If the reservoir and the pump were at the same level, gravity would have no effect on fluid flow. If the reservoir was at a level below the pump, fluid would tend to run out of the pump and into the reservoir. Most hydraulic system reservoirs of current Army aircraft are vented.

Pressurized Reservoirs. In hydraulic systems of some aircraft, it is necessary to mount the reservoir at a level below the pump. This location deters the weight of the fluid rather than aids the flow of fluid into the pump. A pressurized reservoir must have its fluid under greater than atmospheric pressure to force it upward into the pump. A pressurized reservoir also enables aircraft to fly at very high altitudes. Since atmospheric pressure decreases as altitude increases and at very high altitudes becomes too low to force enough fluid into a pump, the reservoir has to be pressurized. The two general methods used to pressurize reservoirs are the fluid method and the air method.

Fluid Method. This method uses the fluid pressure bled from the pressure lines of the system in which the reservoir is incorporated. The reservoir is designed to develop a relatively low pressure on the supply fluid contained in the reservoir by using a stream of fluid fed into the reservoir at a much higher pressure. This reservoir is commonly called an airless reservoir. Figure 4-1 illustrates the construction and operation of a typical reservoir pressurized in this manner. The major parts of the assembly are a cylindrical housing that has three fluid ports and a polished bore, a housing tube which terminates in a head, a piston, and a piston-tube assembly. The piston and piston-tube assembly are free to slide in and out of the housing. The housing tube and head are stationary. In operation, fluid pressure admitted to the housing tube at system operating pressure--for example, at 3,000 psi--enters the space formed between the piston and the housing-tube head. This pressure tends to force the piston and housing-tube head in opposite directions. However, since the housing-tube head cannot move and the piston can, the piston moves toward the right, pushing against the supply fluid on its right, which develops pressure in the fluid. The surface of the housing tube is exposed to 3,000-psi pressure within a space that is one-sixtieth as large in area as the piston surface that contacts the supply fluid. This means that a pressure of 50 psi (3,000 psi divided by 60) is built up in the supply fluid. (See Figure 4-2.)

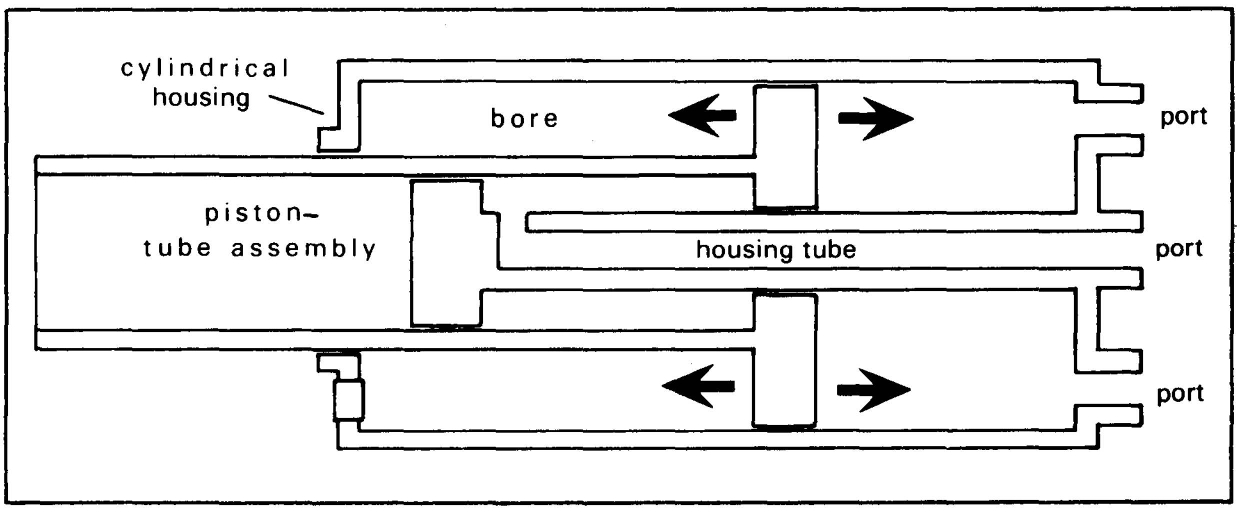

Figure 4-1. Schematic of a fluid-pressurized reservoir.

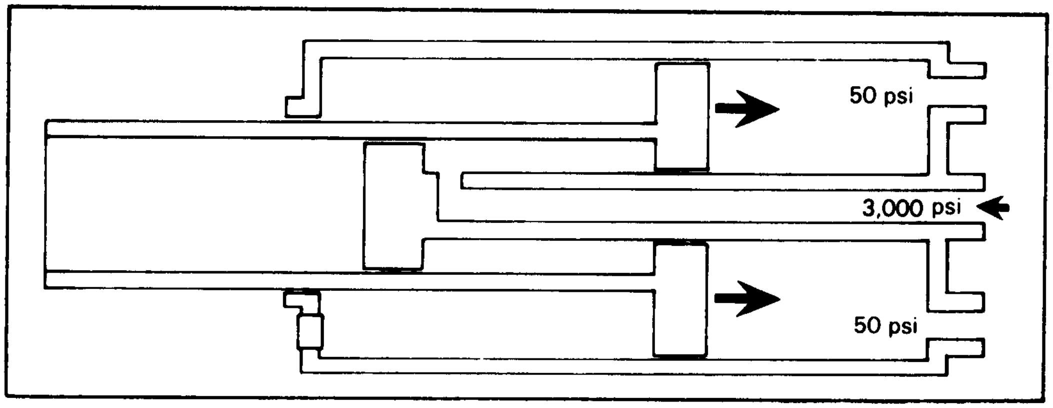

Figure 4-2. Hydraulic reservoir pressurized with fluid.

Air Method. This method forces air into the reservoir above the level of the fluid. The amount of pressure kept in an air-pressurized reservoir is usually around 15 psi. No attempt is made to keep the air and fluid separated. In most cases, the initial source of air-pressure is the compressor section of the aircraft enqine. Since pressure within the engine compressor is normally about 100 psi, it has to be reduced before being delivered to the reservoir. This is done by passing air through an air-pressure regulator.

COMPONENTS

Baffles and Fins. Baffles and fins (Figure 4-3) are used in most reservoirs to prevent the fluid within the reservoir from swirling and surging. These conditions could cause fluid to foam and air to enter the pump along with the fluid.

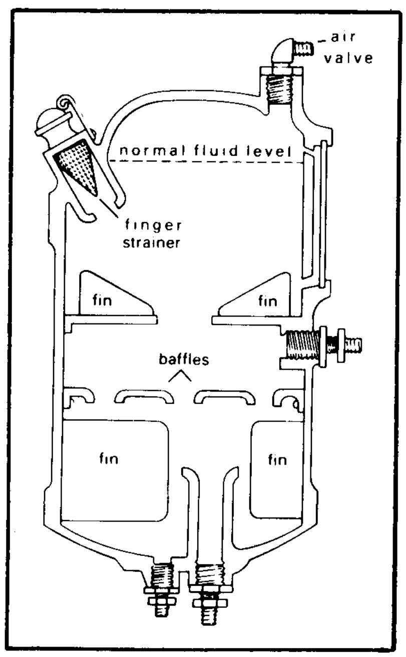

Figure 4-3. Reservoir with baffles and fins.

Finger Strainers. Many reservoirs have strainers in the filler neck to keep foreign matter from entering the reservoir when the filler cap is off. These strainers are made of fine gauze and are called finger strainers because of their shape. Finger strainers should never be removed or punctured to speed the pouring of fluid into the reservoir.

Filter Elements. Filter elements filter the air before it enters the reservoir or the fluid before it leaves the reservoir. An air-vent filter element is located in the upper part of the reservoir above the fluid level. A fluid filter element is located at or near the bottom of the reservoir. Fluid returning to the reservoir surrounds the filter element and flows through the wall of the element. This leaves any fluid contaminant on the outside of the element. The fluid filter elements commonly used in aircraft reservoirs are made of treated cellulose formed into accordion-like pleats. This construction exposes the fluid to the maximum amount of filter surface within a given space. Reservoirs having filter elements have a bypass valve to ensure that the pump will not be without fluid even if the filter element becomes clogged. This valve is normally held closed by a spring; it would be opened by the stronger partial vacuum if the element became badly clogged. Figure 4-4 shows a reservoir with all the filter elements.

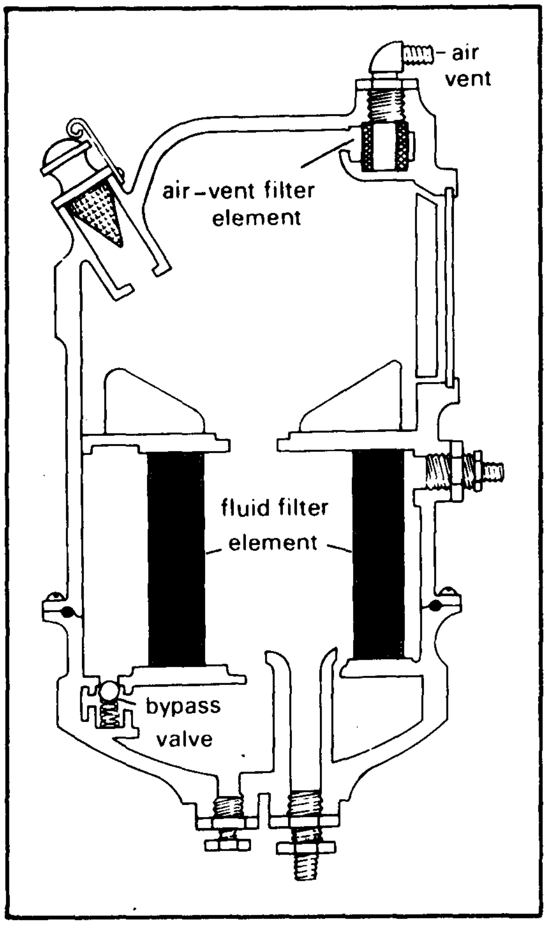

Figure 4-4. Reservoir with filter elements.

EMERGENCY SOURCES

Standpipes. Some aircraft have emergency hydraulic systems that take over if the main system fails. In many cases, the pumps of both systems obtain fluid from a single reservoir. Under such circumstances, fluid for the emergency pump is drawn from the bottom of the reservoir; the main system draws its fluid through a standpipe located at a higher level. This arrangement ensures the operation of the emergency system if the main system fails.

Air Cylinders. Air cylinders are the pneumatic reservoirs in an aircraft's pneumatic system which serve as an emergency source of pressure for the hydraulic system. These cylinders are made of steel and may have a cylindrical or spherical shape. A spherical air cylinder is illustrated in Figure 4-5. Cooling of the high-pressure air in the storage cylinders will cause some condensation to collect in them. Storage cylinders must be cleared of moisture periodically to ensure a positive operation of systems. This is done by slightly cracking the moisture-drain fitting located-on the cylinder manifold.

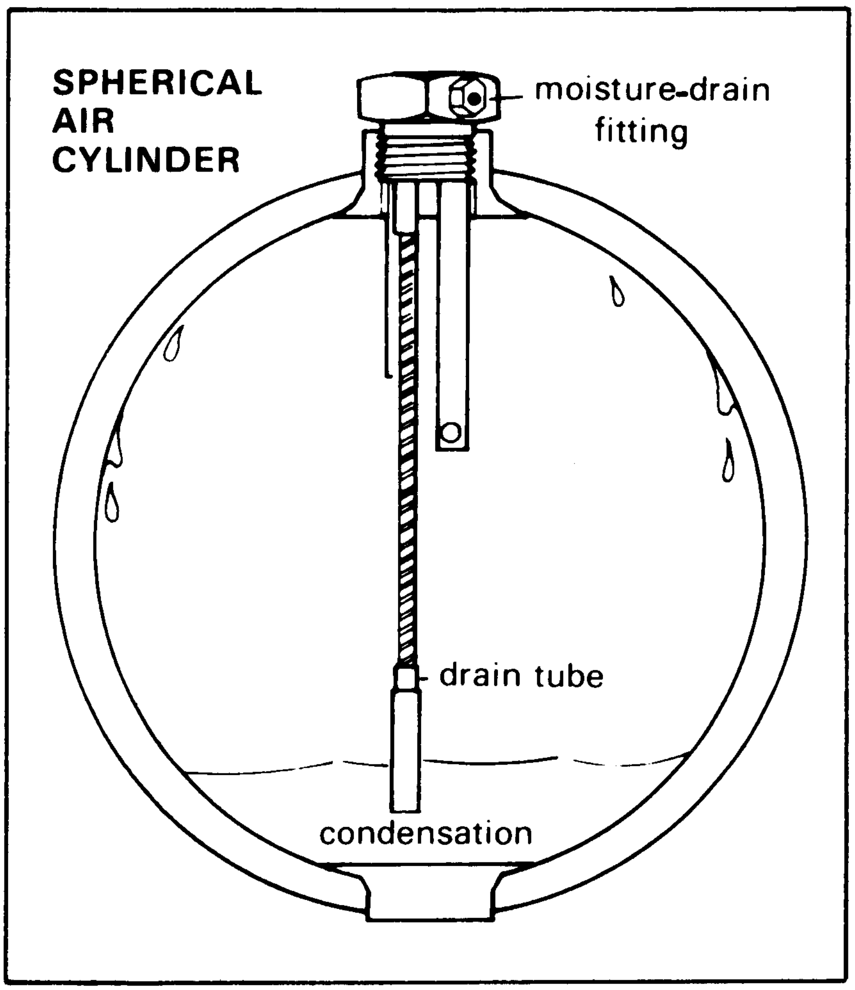

Figure 4-5. Spherical air cylinder.